DAVE, GAURAV J., Dr.P.H. Validation of Self-Reported Hypertension Status and Predictors of Uncontrolled Blood Pressure Levels in the Community Initiative to Eliminate Stroke (CITIES) Project. (2011)
Directed by Dr. Daniel L. Bibeau. 101pp.

Few studies have comprehensively investigated the validity of self-reported hypertension (HT) and assessed predictors of HT status in the stroke belt. The purpose of phase I of this study aims to evaluate self-reporting as a valid tool to screen large study populations and determine predictors of congruency between self-reported HT and clinical measures.

Community Initiative to Eliminate Stroke project (n=16,598) was conducted in two counties of North Carolina in 2004-2007, which included collection of self-reported data and clinical data of stroke-related risk factors. Congruency between self-reported hypertension status and clinical measures was based on epidemiological parameters of sensitivity, specificity and predictive values. McNemar's test and Kappa agreement levels assessed differences in congruency, while unadjusted odds ratios and logistic regression determined significant correlates of congruency.

Sensitivity of self-reported HT was low (33.3%), but specificity was high (89.5%). Prevalence of self-reported HT was 16.15%. Kappa agreement between self-report and clinical measures for BP was fair ($\kappa = 0.25$). Females, whites and young adults were most likely to be positively congruent, whereas individuals in high risk categories for total blood cholesterol, LDL, triglycerides and diabetes were least likely to be accurate about their HT status. Self-report HT information should be used with caution for epidemiological investigations.

The purpose of phase II of this study was to evaluate demographic sub-groups, self-reported health information and clinical measures as predictors of uncontrolled systolic and diastolic hypertension among individuals taking blood pressure lowering medications. Systolic hypertension is the most common form of hypertension among older individuals. Inadequate controls of systolic blood pressure have been largely attributable for poor control of overall hypertension rates. The National Heart Blood Pressure Education Program's guidelines for management of hypertension emphasize the importance of controlling isolated systolic hypertension in older individuals.

The Community Initiative to Eliminate Stroke was a stroke risk-factor screening and reduction/prevention project conducted in two North Carolina counties. The initiative collected self-reported information such as personal history of atrial fibrillation and clinical measures, such as blood pressure levels, among other cardiovascular and stroke risk factors. Statistical modeling of predictors was based on odds ratios and logistic regression analyses.

Of the 2,663 participants, 43.5% and 22.8% had uncontrolled systolic and diastolic hypertension, respectively. African Americans were more likely to have uncontrolled systolic or diastolic hypertension as compared to whites. Similarly, participants older than 55 years of age were more likely to have uncontrolled systolic hypertension compared to younger individuals. Regression analyses indicated that race (OR = 1.239, $p = 0.00$), age (OR = 1.683, $p = 0.00$) and non-adherence with medications (OR = 2.593, $p = 0.00$) were significant predictors of uncontrolled systolic blood pressure levels. Based on the recommendations made by national guidelines and our findings,

future interventions should focus on management of systolic hypertension among older individuals and African Americans to increase the overall control of hypertension.

VALIDATION OF SELF-REPORTED HYPERTENSION STATUS AND PREDICTORS OF UNCONTROLLED BLOOD PRESSURE LEVELS IN THE COMMUNITY INITIATIVE TO ELIMINATE STROKE (CITIES) PROJECT

by

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A Dissertation Submitted to
The Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Public Health

Greensboro
2011

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To my wife:

~ A sincere and heartfelt thank you for your support, and encouragement. I am honored to have you as my family. Your unconditional love has given me the motivation to succeed in all aspects of life.

APPROVAL PAGE

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ACKNOWLEDGEMENTS

I would like to sincerely thank my advisor, Dr. Daniel L. Bibeau and committee members, Drs. Mark Schulz, Robert Aronson and Luba Ivanov, whose mentorship and support has guided me while completing this dissertation. This committee has generously provided me with their time and experience in order to complete my work.

I also appreciate the help of Mr. Robert Romanchuk, Ms. LaPronda Spann, Dr. Chere Chase from the Community Initiative to Eliminate Stroke (CITIES) Project, Moses Cone Health Systems and Forsyth Medical Center for the project support, sample recruitment and data collection.

This research was supported by the grant from the Office of Minority Health, United States (U.S.) Department of Health and Human Services (DHHS).

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CHAPTER I

INTRODUCTION

Heart disease is the leading cause of death for both men and women in the United States (U.S.) followed by cancer and stroke.[1] The most common type of heart disease in the U.S. is coronary artery disease (CAD), also known as coronary heart disease (CHD).[1, 2] Collectively, cardiovascular diseases (CVD) which includes, hypertension, CHD and stroke have been the leading causes of death in the U.S. since 1900.[3]

The overall prevalence rate (for both sexes) of CVD in 2006 was 36.9% for individuals aged 20 years or older. The prevalence rates of CVD among males and females aged 20 years and older were 37.9% and 35.7% respectively with the highest prevalence reported for both non-Hispanic black males and females aged 20 years and older at 44.6% and 46.9% respectively.[4]

A study conducted by the American Heart Association found that Hispanic women were twice as likely to help someone lose weight or add physical activity in their daily routine in the last 12 months compared to non-Hispanic whites and non-Hispanic blacks. Furthermore, physician encouragement was one of the most cited reasons by Hispanic women that prompted them to take preventive action more often than non-Hispanic white women.[5] Hispanics were also found to be more likely to be non smokers compared to non-Hispanic whites and non-Hispanic blacks.[3]

In 2006, the overall annual death rate (per 100,000) due to CVD was 262.5, 306.6 for white males, 422.8 for black males, 215.5 for white females, and 298.2 for black females.[4] Approximately, half of the deaths for women in 2006 were due to heart disease.[1] When examined spatially, we see stark differences between regions across the U.S. The highest age-adjusted average annual deaths per 100,000 for adults aged 35 years and older is in the southeastern counties of the U.S.

The trends over time however have been promising. There has been a steady decline in CVD death rates by 26.4% from 1995-2005 with a 9.5% decline in actual number of CVD deaths per year.[4, 6] Although the CVD death rates have been declining in the past decade the burden of the disease still remains high. Based on mortality data from 2006, approximately 2300 Americans die of CVD each day, an average of 1 death per 38 seconds. In 2006, although the average life expectancy was 77.7 years, 33% of deaths due to CVD occurred before the age of 75 years. In 2006, 1 in every 2.9 deaths in the U.S. was caused due to CVD.[3, 4, 6]

According to the Framingham Heart Study (FHS), CHD is the most common type of CVD in the U.S. and accounts for more than half of all CVD related events among men and women aged 75 years and younger.[7] The lifetime risk of developing CHD after 40 years of age is higher among men (49%) compared to women (32%).[8] The Atherosclerosis Risk in Communities (ARIC) study reported that, the average age-adjusted CHD incidence rates per 1000 person-years for participants between 45-60 years of age, were highest among white men and black men (12.5 and 10.6 respectively) compared to white women and black women (4 and 5.1 respectively).[9]

The National Health and Nutrition Examination Survey (NHANES 2003-2006), analyses found that the total prevalence of CHD in 2006, among U.S. adults aged 20 years and older was 7.9%. CHD prevalence is higher among men compared to women and highest among non-Hispanic white men (9.4%) compared to non-Hispanic black men (7.8%), and non-Hispanic black women (8.8%) compared to non-Hispanic white women (6.9%).[6, 10] Preliminary data findings from the ARIC study and Cardiovascular Health Study (CHS), estimate that approximately 785,000 Americans will suffer from a new coronary attack and 470,000 will have a recurrent coronary attack.[3]

In 2006, the overall CHD death rate was 134.9 per 100,000, with the highest rate reported for black men. In 2006, CHD-specific mortality rates/100,000 were 176.3 for white males and 206.4 for black males; and 101.5 for white females and 130.0 for black females.[4, 6] The overall CHD death rates have decreased by 59% from 1990-1999, and annual death rate due to CHD declined by 36.4% from 1996-2006. But CHD still remains the largest major cause of death in the U.S. accounting for approximately 1 in 6 deaths in 2006.[2, 3, 4, 11] It is estimated that 34% of individuals who suffer from a coronary attack i.e., heart attacks and angina caused due to an underlying CAD and 15% of individuals who suffer from myocardial infarction (MI) i.e., heart attack as a result of interruption of blood supply to the heart muscle, in a year will die of it.[3] A study investigating lifetime risk of CHD for participants involved in the FHS found that there was little or no change in the overall distribution between 10-year risk i.e., ages 40, 50, 60 and 70 for developing CHD.[8]

Stroke is the third leading cause of death and the leading cause of disability in the U.S.[1] In 2006, the prevalence rate for both sexes aged 20 years and over was 2.9% with a higher prevalence rate among women (3.2%) compared to men (2.5%). Approximately, 795,000 people suffer from a new or recurrent stroke and overall, 87% are ischemic, 10% are intracerebral hemorrhage, and 3% are subarachnoid hemorrhage strokes.[12] On an average 1 stroke occurs every 40 seconds in the U.S. Geographically, the stroke-related death rates are higher in the Southeast and Midwest regions of the U.S. compared to the Northeast.[13]

The stroke incidence rate is higher among younger men compared to younger women but this pattern does not hold at older ages.[12] Data analysis from the ARIC study and Warfarin-Aspirin Symptomatic Intracranial Disease Study (WASID) trial have shown that blacks have twice the risk of first-ever stroke compared to whites.[14] The age-adjusted stroke incidence rates in black men aged 45 to 84 years is 6.6 per 1000 population, 3.6 in white men, 4.9 in black women, and 2.3 in white women.[12]

Approximately 39% of this racial discrepancy has been attributed to disparities in community socioeconomic status.[15] An increased incidence rate and racial disparity in the occurrence of first-ever stroke is also seen among Mexican Americans compared to non-Hispanic whites. According to Basic Attack Surveillance in Corpus Christi (BASIC, NINDS), authors found that the crude cumulative incidence of stroke was 168/100,000 in Mexican Americans compared to 136/100,000 in non-Hispanic whites. The study also found that the Mexican Americans had twice the risk (relative risk = 2.04) of ischemic stroke at younger ages (45-59 years) compared to non-Hispanic whites.[16] Similar results

were demonstrated in other studies emphasizing the racial disparity in first ever ischemic stroke incidence among Mexican Americans and blacks compared to non-Hispanic whites.[14, 17]

In 1980, the National Heart, Lung, and Blood Institute (NHLBI) examined the age-adjusted stroke mortality data in each state and found that, eleven states had stroke mortality rates higher by more than 10% than the national average. Of these eleven states, ten states formed a cluster in the southeast region of the U.S. NHLBI coined the term 'stroke belt' emphasizing the burden of stroke in these states of the U.S. and consequently funded 11 pilot projects in 1991 to reduce the burden of stroke in these eleven states. Although, black men and women have higher incidence rates and mortality rates of stroke in the U.S., it was observed that white men and women also had higher incidence and mortality rates in the southeast region of the U.S. Therefore, race alone could not be attributed for the disparity of stroke incidence and mortality in this region.[18]

Several studies have investigated the association between stroke risk factors, migratory patterns, occupational structure and mortality rates. These studies found that, even after adjusting for stroke risk factors, the mortality rate due to stroke was highest in the southeast parts of the U.S.[19, 20, 21, 22] This geographical pattern of stroke incidence and mortality, observed since 1960s, has evolved and changed considerably in the last 25 years. For example, a majority of counties in the coastal states of North Carolina, Georgia, South Carolina and Alabama reported high stroke mortality rates in 1962. Of these, three states were coined as the 'stroke buckle' i.e. states with the highest stroke mortality rates compared to other states of the stroke belt. Since then, in 1988 the high

stroke mortality rates had shifted to counties in the Mississippi delta and the Ohio River valleys.[19, 23]

Previous hypotheses such as physical properties in the environment of the southeast region, climatic conditions, softness of water, deficiency of trace elements in the soil etc. have not been confirmed and have failed to explain the stroke belt phenomenon.[19] Therefore, the authors suggest development and exploration of newer hypotheses that will allow researchers to focus on factors such as accuracy of diagnosing and reporting stroke, social and economic conditions, the prevalence of risk factors for stroke, the direction of migration patterns, the access and quality of health care systems.[19, 20]

The risk factors of CVD are mainly divided into three categories as follows:

A. Biological indicators include:
    1. High blood pressure (hypertension) – is increased pressure exerted by the blood on the walls of the arteries which will eventually increase the risk of CHD and stroke. Smoking, alcohol use and physical inactivity are some of the major risk factors that lead to high blood pressure. More than often, there are no symptoms of high blood pressure and it is often referred to as the 'silent killer'.
    2. High blood cholesterol – leads to the deposition of fats in the arteries that may develop into a plaque. This plaque leads to the development of atherosclerosis that will eventually hinder blood flow to parts of the body leading to CHD and

stroke. Diets high in cholesterol, physical inactivity and family history are some of the major risk factors of high blood cholesterol levels.

3. Personal history of heart diseases (example: coronary heart disease can lead to stroke).
4. Diabetes mellitus (high blood glucose levels) – tend to exacerbate high blood pressure and cholesterol levels in the blood.
5. Overweight and obesity – leads to increased blood cholesterol levels, elevated blood pressure levels and development of diabetes mellitus.
6. Previous history of transient ischemic attack (TIA), and sickle cell disease (associated with ischemic stroke).

B. Behavioral indicators include: Tobacco use (smoking), physical inactivity, high cholesterol diet, and alcohol use.

C. Hereditary indicators include: Family history of CVD and stroke.

The aforementioned risk factors may act synergistically to cause heart disease and stroke.[24] A study investigating three prospective cohort studies reported that 90% of CHD patients have a prior exposure to at least one of the following risk factors which include high blood pressure or current medication with BP lowering drugs, high total blood cholesterol levels or current medication with cholesterol lowering drugs, current cigarette use, and clinical report of diabetes (high blood glucose levels).[24]

INTERHEART, a case-control study conducted in 52 countries reported that optimization of nine risk factors (cigarette smoking, abnormal blood lipid levels, hypertension, diabetes, abdominal obesity, a lack of PA, low daily fruit and vegetable

consumption, alcohol overconsumption, and psychosocial index) that are easily measured and modifiable, could lead to a 90% reduction in the risk of an initial MI. These results were consistent for both men and women across different geographical regions.[25] The CHS study was conducted in four communities: Forsyth County, NC; Sacramento County, CA; Washington County, MD; and Pittsburgh, PA) of the U.S. The main goal of the study was to investigate risk factors associated with onset and course of CHD and stroke. The researchers of the CHS study found that subclinical CVD was very prevalent in older adults aged 65 years and over and the risk of CHD increased dramatically among participants with hypertension and/or diabetes mellitus.[26] According to the Prospective Registry Evaluating Myocardial Infarction: Events and Recovery (PREMIER) trial, 2 multi-component behavioral interventions significantly reduced the 10-year CHD risk among individuals with pre-hypertension or stage I hypertension.[27]

Several research studies funded by NHLBI such as FHS, CHS and Honolulu Heart Program (HHP) have shown that blood pressure is a strong determinant of CHD, ischemic stroke and intracranial hemorrhage. The lifetime risk of stroke is doubled in individuals with high blood pressure compared to individuals with a blood pressure level of less than 120/80 mmHg. Atrial fibrillation alone will increase the risk of stroke by fivefold throughout all ages.[28, 29] Cigarette smoking doubles the risk of ischemic stroke among smokers compared to non-smokers.[3] Diabetes mellitus also increase the risk of ischemic stroke, particularly in blacks before the age of 55 years and in whites before the age of 65 years.[30] According to the Framingham Offspring Study, detection of silent

cerebral infarct was strongly associated with Framingham Stroke Risk Profile score, hypertension, and atrial fibrillation among other factors.[31]

According to NHANES data (1999-2004), women between ages 45-54 years are more than twice as likely as men to suffer from stroke.[32] Women's Health Initiative (WHI), a randomized trial found that estrogen and progestin contained in hormone replacement therapy increased the risk of ischemic stroke by 44% among post-menopausal women.[33] The increased risk was evident in women of all age groups, with or without hypertension and prior history of CVD. An early increase in overall stroke rate and increased rate of fatal stroke was reported in the first six months of therapy with estrogen alone among women with a mean age of 71 years.[34] Other analyses from the WHI study have also shown that hormone replacement therapy that includes estrogen and progestin or estrogen alone does not reduce the risk of ischemic stroke among postmenopausal women, generally healthy women and women with established CVD.[33, 35] Early menopause, i.e. menopause before the age of 42 years, doubles the risk of ischemic stroke compared to women in different age groups.[36]

Collectively, cardiovascular diseases (CVD) and stroke are the leading causes of death in the United States and are included among the focus areas (focus area 12) in Healthy People 2010.[37, 38] Hypertension (HT) is one of the chief risk factors leading to the development of CVDs and stroke in the U.S.[37] According to the seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC), worldwide prevalence of hypertension is estimated to be approximately one billion and 7.1 million deaths may be attributable to hypertension. The

World Health Organization reports that systolic blood pressure levels greater than 115 mmHg (normal: less than120 mmHg) may be responsible for 62 percent of CVD and 49 percent of ischemic heart disease (IHD), one of the CVD's.[39] It is important to note that HT is not only a component of CVD but also an isolated risk factor for the development of other CVDs.

CHAPTER II

REVIEW OF HYPERTENSION LITERATURE

Introduction

HT is defined[3] as – systolic BP level of 140 mmHg or more or diastolic BP level of 90 mmHg or more or taking anti-hypertensive medications or having been told by a physician or other health professional that one has HBP at least twice. One in three Americans suffer from HBP.[40] Approximately 33.6% of adults in the U.S. aged 20 years and over suffer from HBP in 2006 which include 34.4% males and 32.6% females.[3] According to NHANES data, men have higher rates of HBP compared to women until the age of 45 years. The prevalence rates are similar for both sexes between the ages of 45-54 years, after which a much higher percentage of women have HBP compared to men.[41] Furthermore, HBP is more prevalent among women who are taking oral contraceptives and are obese or overweight compared to women who are not.[42]

NHANES data (2005-2006) reported that 29% of Americans who were 18 years of age and over had HBP. Pre-hypertension was prevalent among 28% of the U.S. adults and data findings suggested that 7% of those who had hypertension were never told about their condition. Among those who suffered from HBP, 78% of U.S. adults were aware of their condition and 64% of those were taking antihypertensive medications. Approximately 68% of those who were taking some form of HBP lowering medications, had their BP under control.[43]

A study that analyzed data from National Health Examination Survey (NHES), Hispanic Health and Nutrition Examination Survey (HHANES), NHANES and NCHS surveys conducted from 1963 to 2000 found that pre-hypertension and HBP prevalence trends increased by 2.3% and 1% respectively between 1988-1999 among children and adolescents aged between 8-17 years. An increase in abdominal obesity prevalence after 1988 was partially attributed to this increasing trend.[44]

The prevalence of HBP is highest among blacks in the U.S. The prevalence of HBP has significantly increased for both blacks (35.8% to 41.4%) and whites (24.3% to 28.1%) respectively from 1988 to 1994 through 1999 to 2002. The prevalence of HBP is specifically high for black women at 44%.[45] Blacks develop HBP earlier in life as compared to whites and have average BP levels much higher than whites. Therefore, blacks have 1.3-times greater rate of nonfatal stroke, a 1.8-times greater rate of fatal stroke, a 1.5-times greater rate of death due to heart disease and a 4.2-times greater rate of end-stage kidney disease compared to whites.[39] Research and data have shown that blacks with the highest rate of HBP are more likely to be middle-aged or older, less educated, overweight or obese, lack physical activity and more likely to suffer from diabetes mellitus. Blacks with the lowest rate of HBP are younger in age but interestingly tend to be overweight or obese. It has also been observed that blacks who have uncontrolled HBP or are not taking any anti-hypertensive medications are usually males who are young and do not have frequent contact with a physician.[45, 46]

Findings from the Reasons for Geographic and Racial Differences in Stroke Study (REGARDS) of the NINDS conducted between 2003 – 2007 suggested that racial

disparities with regard to the control of HBP continue to exist with the odds of control being 27% lower in blacks than whites.[47] The 2008 National Health Interview Survey (NHIS) found that black adults who were 18 years of age and older were more likely to be told on 2 or more occasions that they have HBP compared to other racial/ethnic groups.[10] Furthermore, analysis of the combined NHIS data from 2000 and 2002, showed that black Hispanics were more likely to have HBP compared to white Hispanics and non-Hispanic blacks had the greatest risk of developing HBP. It was also reported that higher income and highly educated black Hispanics were still at a greater risk of developing HBP compared to low income and less educated white Hispanics.[48]

The ARIC study (NHLBI) suggests that HBP among blacks, especially in black women is a strong predictor of CHD.[49] The good news is that the seventh report of the JNC found that the age-adjusted mortality rates for CHD and stroke have lowered from 60 percent to 50 percent due to an increase in diagnosis and treatment of hypertension by blood pressure lowering medications. Although the mortality rates have declined by 10 percent, the Framingham Heart Study researchers found that the lifetime risk for hypertension among non-hypertensives after the age of 55 years is approximately 90 percent for both men and women in the U.S.[39] In 2006, the overall death rate due to HBP as a primary or contributing cause was 17.8 with the highest rate reported among black males (51.1), black females (37.7), compared to white males (15.6) and white females (14.3).

Risk Factors of Hypertension

The risk factors for hypertension are divided into non-modifiable (individuals who are born with certain attributes that cannot be changed/altered) and modifiable (individual and environmental behaviors and attributes that can be modified/changed) risk factors. Non-modifiable risk factors include: (a) age - lifetime risk of developing HBP increases with age; (b) ethnicity - blacks are more prone to develop HBP compared to other ethnic groups; (c) family history of HBP - Individuals with a known history of HBP within the family are more prone to develop HBP compared to those with no family history of HBP; and, (d) genetic factors. Modifiable risk factors include: (a) less education; (b) low SES; (c) overweight or obesity; (d) lack of physical activity; (e) tobacco use; (f) physiological stressors; (g) high dietary sodium intake; (h) low potassium dietary intake; and, (i) excessive alcohol use.

Types of Hypertension

1. Essential Hypertension: also known as primary hypertension refers to HBP for which no cause can be found. A majority of U.S. adults (90-95%) suffer from this type of HBP in which several modifiable and non-modifiable risk factors contribute synergistically to the development of HBP.
2. Non-essential Hypertension: also known as secondary hypertension refers to HBP caused due to certain temporary and controllable conditions such as pregnancy and/or use of certain medications. A few chronic conditions such as hormonal diseases, renal diseases or head injuries can also lead to the development of

secondary HBP. This type of HBP affects approximately 5-10% of the U.S. population.

Management of Hypertension

The two aspects of management of HBP include (1) pharmacological therapy that aims at reducing and controlling one's systolic or diastolic or both levels of BP, and (2) public health management that aims at increasing awareness about HBP and its risk factors, early detection and prevention via modification of environmental attributes and unhealthy risk behaviors and primary prevention and management via lifestyle changes.

Pharmacological Management

Over the past several decades, there have been numerous drug trials and advances in the management of HBP. A wide range of anti-hypertensive drugs are now available that can be used alone or in combination with other anti-hypertensive drugs to control HBP. The JNC reports that more than two-thirds of individuals suffering from HBP will require more than one anti-hypertensive drug to control HBP (SBP < 140 mmHg and DBP < 90 mmHg).[50, 51, 52, 53, 54] The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT), conducted in 1994, found that only 30% of participant's BP were controlled by one drug as compared to 60% of participants whose BP were controlled by the use of two or more anti-hypertensive agents.[55] Thiazide-type diuretics have shown success in most placebo-control outcome trials and form the basis for anti-hypertensive therapy. The diuretics have been proven to reduce CHD, heart failure and stroke risk, among other CVD events.[55, 56, 57, 58, 59]

Other randomized controlled and clinical trials (European Trial on Systolic Hypertension in the Elderly (Syst-EUR),[60] Heart Outcomes Prevention Evaluation (HOPE) Study,[61] The European Trial on Reduction of Cardiac Events with Perindopril in Stable Coronary Artery Disease (EUROPA) study[62] etc.) have shown success in controlling HBP and include anti-hypertensive agents such as loop diuretics, potassium-sparing diuretics, Aldosterone-receptor blockers, beta-blockers, combined alpha and beta-blockers, Angiotensin-converting enzyme inhibitors (ACEI), Angiotensin II blockers, calcium-channel blockers, Alpha-1 blockers, Alpha agonists and directly acting vasodilators.

JNC report provides recommendation with regards to the pharmacological treatment of HBP. As per JNC report, thiazide-type diuretics are recommended as first-choice drugs in the line of treatment of HBP. This recommendation is based on the evidence generated in multiple drug trials, which have shown increasing efficacy and effectiveness of thiazide-type diuretics compared to other drug options in preventing CVD-related events.[39] The ALLHAT study found that there were no differences between thiazide diuretic (chlorthalidone), ACE-Inhibitor (lisinopril) and calcium-channel blocker (amplodipine) with regards to primary CHD outcomes and mortality. The study also reported that individuals treated with either calcium-channel blocker or ACE-Inhibitor had greater incidence of heart failure compared to individuals treated with a diuretic.[64] Thiazide-type diuretics have been proven to be generally safe and inexpensive compared to other anti-hypertensive drugs.[54, 63, 64]

Public Health Management of HBP

There have been substantial improvements from a public health perspective in raising awareness, treating and controlling HBP levels. But these improvements have not been exemplified in the total population. For example, data from the National Health Examination Survey (NHES) conducted between 1976 and 2003, has shown that approximately one-third of the U.S. population who have HBP are unaware of their HBP, more than 40% of individuals with HBP are not taking any BP-lowering medications and two-thirds of the population who are on anti-hypertensive treatment are not being controlled to BP levels of 139/89 mmHg or less.[39]

At the same time, the decline in CHD and stroke associated mortality rates have slowed down while hospitalizations (see figure 10) related to heart failure have increased in the past decade.[65] One study suggested that the decline in CHD mortality was attributable to medical therapies and adoption of lifestyle and environmental changes that led to changes in CHD risk factors in the population.[66] Moreover, authors from another study also found that there was an increased usage of medical procedures such as cardiac catherterization, percutaneous transluminal coronary angioplasty, and bypass graft surgery that led to increased hospitalization rates between 1979 to 2005.[10]

In lieu of the fact that as age progresses, lifetime risk of an individual to suffer from HBP also increases, it is imperative to compliment HBP treatment strategies with public health interventions. As mentioned in the section *'Risk Factors'*, there are several modifiable risk factors of HBP that can be measured and controlled. These factors include excess body weight, lack of physical activity, lack of fruits and vegetables in the

diet, high dietary sodium and cholesterol intake, cigarette and alcohol use.[67] JNC 7 has recommended a model guideline that includes management of HBP via lifestyle modifications and anti-hypertensive treatment. The recommendations focus on adjusting or modifying certain behaviors and reduction of BP levels to 139/89 mmHg or less. It has been shown that a small decrease in systolic BP by 5 mmHg, can lead to a reduction in CHD-associated and stroke-associated mortality by 9% and 14% respectively.[67, 68]

JNC recommends that initiation of therapy for HBP should begin with lifestyle modifications. These modifications include and are not limited to, reduction in sedentary activities such as watching TV or spending time online and playing video games, increasing physical activity to include moderate exercise for 30 minutes per day on most days of the week, reduction in dietary salt intake and inclusion of fruit and vegetable servings in everyday meals. The Dietary Action to Stop Hypertension (DASH) outlines recommendations for adoption of low sodium diet that promotes inclusion of fruits and vegetables in daily diets. DASH studies have shown that inclusion of heart health foods that are low in cholesterol and sodium have been very beneficial in promoting weight loss, reduction of BP in hypertensive individuals and reduction in low-density lipoproteins.[69]

The recommended lifestyle modifications lead to significant reduction in systolic BP which furthermore, reduces the risk of CHD-associated and stroke-associated events. If the lifestyle modifications do not reduce the HBP levels below 140/90 mmHg, thiazide-type diuretics should be started along with another drug to reduce HBP levels.

The multi-drug treatment should be complimentary to the continuation of maintaining healthy lifestyle and modifying unhealthy behaviors.

Based on the literature review above, the author has identified gaps primarily in two areas of public health research pertaining to CVD, stroke and hypertension. These gaps which are discussed in detail below will allow for exploration of alternative answers and help in formulating recommendations for future research and interventions concerning CVD, stroke and hypertension. The two areas of research that warrant further exploration and research are as follows:

1. Self-awareness of one's blood pressure status via validation and prediction of self-reported HBP status and its implications on future public health research and interventions.
2. Demographic and clinical predictors of level of control of BP measures (systolic and diastolic) and its impact on HBP education in public health, clinical and/or pharmacological settings.

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CHAPTER III

VALIDITY OF SELF-REPORTED HYPERTENSION STATUS AND PREDICTORS OF CONGRUENCY WITH CLINICAL MEASURES

Introduction

Hypertension (HT) is a silent killer affecting one in three U.S. adults.[1] In 2010 it was estimated that HT cost the U.S. $76.6 billion in missed days from work and medical care, including medications.[2] HT is a major risk factor for cardiovascular disease (CVD) and stroke, which are among the top three leading causes of death in the U.S.[3] According to the Framingham Heart Study (FHS), the lifetime risk for developing HT after the age of 55 years is 90 percent for both non-hypertensive men and women.[4] Since the inception of the National High Blood Pressure Education Program (NHBPEP) in 1972, there have been continued efforts to raise awareness, treat and control HT, unfortunately uncontrolled BP levels continue to remain high.[2, 5-7] Therefore, it is imperative to enhance epidemiological surveillance and population-based public health strategies aimed at secondary prevention of HT and/or primary prevention of CVDs and stroke.

Typically, surveillance activities involving HT and its associated risk factors require large populations and clinical measurements that can be very time-consuming and expensive.[5, 8-11] Thus, the emphasis is placed on conducting small-scale, cross-sectional or cohort studies relying on self-reported information about one's HT status.[5, 8-13] These smaller-scale studies can be conducted at local or state levels and are practical, inexpensive and can be comprehensively assessed. Furthermore, results from these

studies, would enable health researchers and practitioners to design community-based interventions targeting populations in most need.

In assessing self-reported data, it is important to pay particular attention to the validity of the information collected and how well this information reflects the clinical measures of BP levels.[5, 8-12, 14, 15] Validity studies involve epidemiologic assessment and reporting of sensitivity, specificity, and predictive values. Few studies have evaluated the validity of self-reported information in the U.S., particularly at regional levels.[9, 11, 16] Even the previous studies that have assessed validity of self-reported HT status have been based on relatively small sample sizes.[10, 16-18] Furthermore, very little is known about the predictors of congruency between self-reported information and one's actual HT status. Although these studies have found mild to moderate sensitivity and high specificity, recommendations with regards to the utility of self-reported BP status as a valid tool to screen large numbers of individuals in a community-based setting have been mixed. Even guidelines and definitions for both self-reported and clinical measures of BP have evolved over the last three decades. Therefore, the interpretation of results in some of these studies becomes difficult in light of the current JNC 7 guidelines and definition of HT.

The purpose of this paper is twofold: (a) to assess the validity of self-reported HT status compared to clinical measures of BP levels in a cross-sectional pool of participants from the 'Community Initiative to Eliminate Stroke (CITIES) project using the most current JNC guidelines; and (b) to determine predictors of the level of congruency between one's self-reported information and actual BP measures. This assessment will

not only allow investigators to evaluate self-reported data as an expedient and reliable tool to screen large numbers, but also enable health professionals to design and implement targeted educational messages aimed at raising awareness of HT and its risk factors.

Methods

CITIES Project

The CITIES project of North Carolina (NC) was a three-year project funded by the Office of Minority Health (OMH), DHHS and awarded to the Forsyth Medical Center (FMC) Foundation in formal partnership with the Moses Cone Health System (MCHS), the University of North Carolina at Greensboro (UNCG) and the North Carolina Agriculture & Technical State University (NC A&T). This initiative was implemented in two NC counties, Guilford and Forsyth, and targeted persons of color, low-income, and rural residents for whom English was a second language. The main components of the CITIES project were: (a) to screen individuals for stroke risk factors; (b) make recommendations and referrals as appropriate for identified risk factors; and (c) provide health education and health promotion activities to reduce the prevalence of stroke risk factors.

Settings and Procedures

Each medical center used a mobile unit and registered nurses (RN) to screen individuals at sites with preset appointments, such as churches, factories, health fairs, etc. and at sites with unscheduled appointments within the two respective counties. A total of 19,621 individuals were screened for stroke risk factors in the CITIES project. A

convenient sub-sample was used to recruit individuals for this study. Participation was voluntary and each participant was included in this study if they were 18 years or older and signed the consent form. The RNs used a standard questionnaire that was divided into three distinct categories, including demographic information, self-reported stroke risk factors, and clinical and biomedical measurements of stroke risk factors.[19] The participants were asked to self-report their hypertension status by answering the following question: "Do you suffer from high blood pressure and/or has a physician/doctor/nurse diagnosed you as a hypertensive?" Inclusion criteria was based on a 'yes' response to the HBP question.

The RNs measured the blood pressure of each participant using an electronic machine – DYNAMAP, which was wet-tested and calibrated every week. A minimum of two measurements were taken in the seated position with the arms outstretched and the lowest BP reading was recorded. If the first reading was high, i.e., high systolic and/or diastolic BP, then BP was measured again after two minutes in the same arm. If the readings on the machine were found to be high on both occasions, then the registered nurses would manually measure the blood pressure twice in the other arm using a calibrated sphygmomanometer, and then record the lowest readings.

All participants who had a BP measurement of 160 mmHg for systolic and/or 100 mmHg for diastolic or higher were referred to an E.R. promptly to get their BP checked again. Other self-reported information included overweight status, smoking, exercise status, and use of BP lowering and lipid-lowering medications. All self-reported information was collected prior to collection of blood samples and recording of clinical

and biomedical measurements. Clinical and biomedical measurements included blood LDL, HDL, total cholesterol, triglycerides and glucose levels. Blood measurements were obtained using finger prick blood screening procedures. BMI was calculated based on height and weight measurements. The RNs also collected demographic information such as age, sex, education etc. from all participants. The project was approved by the respective Institutional Review Boards for all institutions.

Statistical Analyses

JNC 7 defines HT as having a systolic BP level of 140 mmHg or more and/or diastolic BP levels of 90 mmHg or more. Our gold standard i.e. possible diagnosis of HT in our sample was computed based on systolic, diastolic blood pressure levels and classification parameters of HT proposed by JNC 7.[4] Thus possible diagnosis of HT was defined as systolic BP levels of 140 mmHg and/or diastolic BP of 90 mmHg or more. MS Access© was used to input data, which was analyzed using PASW statistics software, version 18.[20, 21] The final sample excluded individuals who were taking BP lowering medications in order to avoid confounding results. The participants' demographic characteristics, self-reported information and clinical measurements were described using frequencies and percentages. Bivariate associations were calculated using cross-tabulations to compare self-reported information (yes and no) from the questionnaire with possible diagnosis of HT (yes and no) based on BP measurements. The validity of the self-reported information was evaluated on the basis on sensitivity, specificity, and positive and negative predictive values. McNemar's test was used to ascertain differences between positively congruent individuals and those who were not congruent. Kappa (κ)

scores were used to assess agreement between self-reported status and possible diagnosis of HT. A κ score of less than 0.20 was considered poor agreement, 0.20-0.40 fair agreement, 0.41-0.60 moderate agreement, 0.61-0.80 substantial agreement, and more than 0.81 as almost perfect agreement.

The dichotomous outcome variable for congruency between self-reported information and clinical data was computed using the cross tabulations for self-reported and possible diagnosis of HT. Congruence between self-reported and measured BP was taken as a measure of being aware of one's HT status, whereas disagreement between self-reported and measured BP was taken as a measure of being unaware of one's HT status. Odds ratios and confidence intervals (CI) at 95% were calculated using standard procedures to assess determinants of positive congruency. Congruency, the outcome variable, was modeled as a function of independent variables including, demographic characteristics, self-report information and clinical measurements. Binary logistic regression and forward likelihood ratio method were used to evaluate statistically significant predictors of HT congruency. The statistical significance for all analyses was based on the conventional alpha level of significance of 0.05.

Results

Table 1 presents the demographic characteristics of the participants. A majority of the participants in the CITIES project were females. Approximately 50% of the participants were Caucasians. More than half (62.2%) of the participants were aged 41 years or older. Approximately 60% of the participants reported an annual income of less than $35,000, while more than half of the participants had more than high school

education. Self-reported risk information is presented in Table 2. Almost 85% of the participants self-reported, 'No,' when they were asked: "Do you suffer from high blood pressure and/or has a physician/doctor/nurse diagnosed you as a hypertensive?" The results of the clinical measures of the participants are reported in Table 3. Less than one third i.e. 20.5% and 14.2% of the participants had systolic or diastolic hypertension in stages I or II respectively.

Among those who self-reported as having HT, slightly more than half of the participants were confirmed to have clinical HT stages I or II for a positive predictive value of 51.2%. More than three quarters (80.3%) of the participants who self-reported as non-hypertensive were confirmed not to have a possible diagnosis of clinical HT stages I or II. Overall, the sensitivity of self-report for correctly identifying those who have HT was 33.31%, while the specificity, i.e., correctly identifying those who did not have HT, was 89.5% (see Table 4). The prevalence of HT in this sample was 16.15% (based on self-reporting) and 24.81% (based on clinical measures of BP). McNemar's test showed that there was a statistically significant difference between those who were positively congruent and those who were not ($p < 0.01$). The overall κ score for agreement between self-reported and clinical measures of BP was 0.25.

Unadjusted ORs showed that females had 1.366 times greater odds of being congruent and aware of their HT status compared to males (see table 5). Caucasians were found to be more aware of their HT status as compared to African-Americans. Similarly, younger populations (18 to 40-year-olds and 41 to 55-year-olds) were also more likely to be congruent for their HT status as compared to older adults. Those individuals who

reported, 'no,' when asked if they had personal and/or family history of CVD tended to be more aware of their HT status compared to those who reported the presence of a personal and/or family history of CVD. Additionally, individuals who self-reported that they did not have diabetes or high cholesterol had respectively 1.6 and 1.9 times greater odds of being congruent compared to those who said 'yes' in all of those situations. For individuals who had normal or optimum levels of blood cholesterol, LDL, HDL, triglycerides, and blood glucose levels, the odds was higher that they were aware of their HT status compared to those individuals whose levels fell into high risk categories. Those who had normal BMI levels (18.5 – 24.9999) had almost 2.5 times greater odds of being congruent than individuals who were obese.

After controlling for other covariates, a multivariate logistic regression using stepwise likelihood ratio model found that gender (p = 0.00), race (p = 0.00), age (p = 0.00), family history of CVD (p = 0.00), self-reported diabetes status (p = 0.02), total blood cholesterol (p = 0.00), HDL levels (p = 0.00), blood triglyceride levels (p = 0.00), and BMI (p = 0.00) were statistically significant predictors of congruency with 5% of variance explained by the final model (see Table 6). These results were similar to the bivariate associations (ORs) discussed above. Cross-tabulations and unadjusted odds ratios were conducted to further explore level of congruency between select groups of individuals that were found to be significant predictors. Approximately 4/5th of the participants (88%) that were white females aged 18-40 years old were positively congruent i.e. more aware of their HT status (n = 3768).

Discussion

The investigators reviewed the validity of self-reported information of one's HT status in comparison to clinical measurements of BP levels in two counties of NC. Our results indicate that the level of congruency between self-reported and clinical measures of HT is low. The sensitivity of self-reported HT status was only 33%. In comparison, other studies that have employed a heterogeneity of research methodologies to investigate validity, reported a moderate to high sensitivity of approximately 50-90%.[9-11, 13, 14, 16-18, 22-26] Only one study, the Utrecht Health Project reported results similar to ours with a sensitivity of 34.5%.[15] Conversely, the specificity of self-reported HT status of 89.5% in our sample was high and was similar to specificity reported in other studies.[9-11, 13-18, 22, 26] The results of high specificity are particularly encouraging, since it has been postulated that in the long-term new incident cases of HT will be eventually diagnosed upon long-term follow-up.[5]

We used McNemar's test and kappa score classification to measure the strength of agreement between self-reported and clinical measures of HT.[27] The overall κ scores indicated only fair agreement between the two in comparison to other studies that have shown a moderate to substantial agreement.[5, 9, 10, 12, 22, 26, 28] Two reasons why validity of self-reported HT was low in our sample could be because HT has a less clear-cut diagnostic criterion in comparison to other diseases, like diabetes, fractures and breast cancer, and HT is a silent killer that does not present clinical signs and symptoms on a daily basis.[8, 15] As a result, the clinical measures, diagnosis, short-term and long-term implications of having HT may not be easily perceived and understood by the patient.

Therefore, it becomes increasingly important for physicians to accurately assess, diagnose and treat HT and for health professionals to raise awareness of the condition among both physicians and patients.

We also found that certain sub-groups in our sample were more congruent, i.e., able to report their HT status more accurately compared to others. Females, whites and younger adults were more accurately aware of their HT status. Similarly, persons who self-reported as normal weight, without a personal or family history of CVD, and without diabetes were also generally more aware of their HT status compared to those who reported a history of CVD, diabetes and /or felt they were overweight or obese. Similar findings have been reported by Muhajarine et al.[29] Interestingly, our analysis found that individuals who fell into high risk categories for blood cholesterol, LDL, HDL, triglycerides, glucose levels and/or BMI were least likely to be congruent compared to individuals who were found to be within normal limits for any of those levels. Based on these findings, it seems that individuals who feel that they are unhealthy based on their self-reported overweight and exercise status or those who have high risk factors for developing HT or any other CVD appear to be least aware of their HT status. One hypothesis for this occurrence could be that these individuals are less likely to see a physician for annual check-ups thereby falling into a vicious cycle of not knowing what their actual health assessment is, leading to a lack of awareness of clinical correlates of HT and CVD and its associated prevention strategies. These individuals then continue to engage in unhealthy behaviors and are thus less likely to change or modify lifestyle behaviors for the betterment of their health.

Giles et al. have found that individuals who had a preventive health care check-up in the last year were more likely to be aware of their HT status.[13] This finding supports the notion that public health campaigns designed to raise awareness of HT and its correlates should also focus on encouraging individuals to access preventive care services, i.e., getting annual physical check-ups. The diabetes education and screening program conducted at Smith Island showed that participants became more aware of their health risks associated with diabetes, hypertension and high cholesterol as a result of the screenings and counseling offered during the screening services.[30] Moreover, the follow-up rates for annual clinic visits increased due to continued efforts to raise awareness and educate residents about these conditions. Although this program was focused on diabetes, interventions targeting HT could be modeled after the Smith Island program to raise awareness of the risk factors of HT and highlight the importance of periodic health check-ups.

Conclusion

Self-reported information for HT should be used only with great care as a screening tool in large, population-based studies. This study found that individuals who had a possible diagnosis of HT based on their clinical measures were likely to report as not having HT. Thus self-reporting could lead to an under-estimation of the prevalence of HT in our population. Several participant characteristics were identified as potential predictors of decreased awareness of one's HT status including males, African-Americans, those age 55 years and older and those who were in a high risk category for several HT and CVD correlates. Future interventions should employ strategies that

increase availability and encourage participation of individuals in preventative care services, including getting an annual physical. Although the diagnosis of HT is a more involved process, future research could focus on evaluating the accuracy of screening data as an indicator of actual diagnosis of HT.

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Tables

Table 1: Demographic Characteristics of Respondents[1] in CITIES Project, NC 2004-2007		
Personal Characteristics	Totals	
	N (16,598)	%
Gender		
Male	5,747	36.3
Female	10,087	63.7
Race		
Caucasian	7,329	47.1
African American	6,758	40.7
Hispanic	514	3.3
Asian/Pacific Islander	456	2.9
Other	513	3.1
Age		
18 to 40 years old	5,965	38.0
41 to 55 years old	6,285	40.0
≥ 56 years old	3,454	22.0
Income		
< $35,000	9,735	64.7
≥ $35,000	5,308	35.3
Education		
Less than High School	1,122	7.2
High School or GED	4,598	29.5
More than High School	9,859	63.3
Ethnicity		
Hispanic/Latino	514	3.3
Non-Hispanic/Latino	15,056	96.7

[1] Totals do not sum to the sample size due to missing data.

Table 2: Self-Reported Characteristics of Respondents[1] in CITIES Project, NC 2004-2007		
Self-Reported Characteristics	Totals	
	N (16,598)	%
Personal h/o[2] CVD		
Yes	701	4.2
No	15,897	95.8
H/o Atrial Fibrillation		
Yes	7,329	47.1
No	6,758	40.7
Family h/o CVD		
Yes	3,868	23.3
No	12,730	76.7
Smoking Status		
Yes	2,880	17.4
No	13,718	82.6
Overweight Status		
Yes	8,248	49.7
No	8,350	50.3
Lack of Exercise Status		
Yes	7,891	47.5
No	8,707	52.5
Hypertension Status		
Yes	2,555	15.4
No	14,043	84.6
High Blood Cholesterol Status		
Yes	2,771	16.7
No	13,827	83.3
Diabetes Status		
Yes	868	5.2
No	15,730	94.8
Stress Status		
Yes	3,726	22.4
No	12,872	77.6

[1] Totals do not sum to the sample size due to missing data.
[2] h/o – history of

Table 3: Clinical Characteristics of Respondents[1] in CITIES Project, NC 2004-2007		
Clinical Characteristics	Totals	
	N (16,598)	%
LDL		
Very High Risk (≥ 190 mg/dl)	297	2.3
High Risk (160-189 mg/dl)	892	7.0
Borderline High Risk (130-159 mg/dl)	2,646	20.7
Near Optimum/Above Optimum (100-129 mg/dl)	5,076	39.7
Optimum (≤ 99 mg/dl)	3,874	30.3
HDL		
High Risk (< 40 mg/dl)	4,072	26.1
Normal (40-59 mg/dl)	7,678	49.1
Preventive (≥ 60 mg/dl)	3,876	24.8
Total Cholesterol		
High Risk (≥ 240 mg/dl)	1,537	9.8
Moderate Risk (200-239 mg/dl)	4,214	26.8
Normal (≤ 199 mg/dl)	9,959	63.4
Triglyceride		
High Risk (≥ 200 mg/dl)	3605	23.0
Borderline High Risk (150-199 mg/dl)	2,696	17.2
Optimum (≤ 149 mg/dl)	9,378	59.8
Blood Glucose		
High Risk (≥ 200 mg/dl)	261	1.7
Moderate Risk (150-199 mg/dl)	472	3.0
Normal (50-149)	14,995	95.3
BMI		
Obese (≥30)	5,318	34.0
Overweight (25-29.9999)	5,496	35.1
Normal (18.5-24.9999)	4,623	29.5
Underweight (≤ 18.5)	209	1.4
Systolic BP		
Hypertension Stage II (≥ 160 mmHg)	666	4.2
Hypertension Stage I (140-159 mmHg)	2560	16.3
Pre-Hypertension (120-139 mmHg)	7,079	45.0
Normal (≤ 119 mmHg)	5,428	34.5
Diastolic BP		
Hypertension Stage II (≥ 100 mmHg)	431	2.7
Hypertension Stage I (90-99 mmHg)	1,816	11.5
Pre-Hypertension (80-89 mmHg)	5,128	32.6
Normal (≤ 79 mmHg)	8,358	53.2
Combined BP (Systolic and Diastolic)		
Hypertension Stages I and/or II	1,519	9.7
Normal and/or Prehypertension	14,122	90.3

[1] Totals do not sum to the sample size due to missing data.

Table 4: Self-Reported HT Status versus Clinical Diagnosis of HT[1] in CITIES Project, NC 2004-2007

Test Characteristics	Clinical Diagnosis of HT		
	Hypertensive	Non-Hypertensive	Total
Self-Reported (Yes)	1,298	1,239	2,537
Self-Reported (No)	2598	10,568	13,166
Total	3,896	11,807	15,703

[1] Totals do not sum to the sample size due to missing data.

Table 5: Bivariate Analysis – Determinants of HT Awareness (Positive Congruence) by Demographic, Self-Report and Clinical Characteristics in CITIES Project, NC 2004-2007

Participant Characteristics	Odds Ratio	95% CI
Gender		
Male (reference)	--	--
Female	1.366*	1.268, 1.472
Race		
African American (reference)	--	--
Caucasian	1.150*	1.065, 1.242
Age		
> 55 years old (reference)	--	--
41 to 55 years old	2.083*	1.903, 2.281
18 to 40 years old	3.157*	2.857, 3.488
Income		
> $35,000 (reference)	--	--
≤ $35,000	1.082	0.942, 1.101
Personal h/o CVD		
Yes (reference)	--	--
No	1.738*	1.481, 2.039
H/o Atrial Fibrillation		
Yes (reference)	--	--
No	1.473*	1.124, 1.929
Family h/o CVD		
Yes (reference)	--	--
No	1.264*	1.164, 1.373
Smoking Status		
Yes (reference)	--	--
No	0.977	0.888, 1.074
Overweight Status		
Yes (reference)	--	--
No	1.426*	1.325, 1.536
Lack of Exercise Status		
Yes (reference)	--	--
No	1.009	0.938, 1.085
High Blood Cholesterol Status		
Yes (reference)	--	--
No	1.597*	1.459, 1.747
Diabetes Status		
Yes (reference)	--	--
No	1.891*	1.638, 2.182
Stress Status		
Yes (reference)	--	--

No	1.034	0.950, 1.126
Total Blood Cholesterol		
High Risk (reference)		
Moderate Risk	1.199*	1.055, 1.362
Normal	1.582*	1.406, 1.781
LDL		
Very High Risk (reference)	--	--
High Risk	0.932	0.699, 1.244
Borderline High Risk	1.120	0.859, 1.460
Near/Above Optimum	1.259	0.972, 1.631
Optimum	1.497*	1.152, 1.947
HDL		
High Risk (reference)	--	--
Normal	1.323*	1.213, 1.443
Preventive	1.337*	1.208, 1.481
Triglycerides		
High Risk (reference)	--	--
Moderate Risk	1.222*	1.094, 1.366
Normal	1.609*	1.476, 1.755
BMI		
Obese (reference)	--	--
Overweight	1.260*	1.158, 1.371
Normal	2.211*	2.006, 2.438
Underweight	2.301*	1.579, 3.354
Blood Glucose		
High Risk (reference)	--	--
Moderate Risk	1.122	0.819, 1.536
Normal	1.974*	1.532, 2.544

* Significant at $p < 0.05$

Table 6: Logistic Regression – Predictors of Non-Congruency by Demographic, Self-Reported and Clinical Characteristics in CITIES Project, NC 2004-2007			
Participant Characteristics	β	Odds Ratio (95% CI)	*p*
Gender			
Female (reference)	--	--	--
Male	0.329	1.389 (1.261, 1.530)*	0.00
Race			
Caucasian (reference)	--	--	--
African Americans	0.163	1.178 (1.069, 1.296)*	0.00
Hispanics/Latinos	0.313	1.367 (1.028, 1.817)*	0.03
Asians/Pacific Islander	0.152	1.165 (0.883, 1.537)	0.28
Others	0.145	1.156 (0.887, 1.507)	0.28
Family h/o[a] CVD			
No (Reference)	--	--	--
Yes	0.175	1.191 (1.078, 1.316)*	0.00
Diabetes Status			
No (Reference)	--	--	--
Yes	0.214	1.238 (1.021, 1.281)*	0.03
Triglycerides			
Normal (reference)	--	--	--
Moderate Risk	0.129	1.137 (1.010, 1.281)*	0.03
High Risk	0.210	1.234 (1.095, 1.391)*	0.00
HDL Levels			
Preventive (reference)	--	--	--
Normal	-0.156	0.856 (0.761, 0.962)*	0.00
High Risk	-0.051	0.950 (0.824, 1.097)	0.48
Age			
18 to 40 years old (reference)	--	--	--
41 to 55 years old	0.632	1.881 (1.688, 2.097)*	0.00
Older than 55-years-old	1.088	2.969 (2.628, 3.354)*	0.00
Total Blood Cholesterol Levels			
Normal (reference)	--	--	--
Moderate Risk	0.140	1.151 (1.041, 1.272)	0.00
High Risk	0.235	1.264 (1.096, 1.459)	0.00
BMI			
Normal (reference)	--	--	--
Underweight	0.150	0.161 (0.726, 1.858)	0.53
Overweight	0.444	1.560 (1.382, 1.760)*	0.00
Obese	0.760	2.138 (1.886, 2.423)*	0.00
$\chi^2 = 4.654$*, $p = 0.03$, Cox & Snell's $R^2 = 0.05$			
* Significant at $p < 0.05$, [a] H/O – history of			

CHAPTER IV

PREDICTORS OF UNCONTROLLED HYPERTENSION INTWO COUNTIES OF THE STROKE BELT

Introduction

Hypertension (HT), defined as having a systolic blood pressure (SBP) level of 140 mmHg and/or a diastolic BP (DBP) level of 90 mmHg and over, is a major risk factor for cardiovascular diseases (CVD) and stroke.[1] HT was either the primary or contributing cause of death for over 300,000 Americans in 2006.[2, 3] The National High Blood Pressure Education Program (NHBPEP) and the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) have stipulated guidelines for treatment and control of HT. These guidelines serve as a platform for all healthcare providers, public health researchers and practitioners to focus on key elements of lifestyle modification and pharmacological aspects of HT management.[4, 5]

Due to ongoing efforts of NHBPEP, the number of individuals in the U.S. who are on medication and thus controlling their BP levels has increased dramatically during the last two decades. According to the National Health and Nutrition Examination Survey (NHANES) report for 1991-1994, of those who were hypertensive and taking BP lowering medications, 53.6% and 27.4% were controlling SBP levels to less than 140 mmHg and DBP levels to less than 90 mmHg, respectively, compared to 31% and 10% respectively in 1976-1980.[2]

In spite of continued efforts to treat and control HT at a national level, success has been limited.[6] There are concerns that the trends reported in the NHANES report may be subsiding.[5] According to the Framingham Heart Study (FHS) by the National Heart Lung Blood Institute (NHLBI), only 38% of men aged 80 years and older and 23% of women aged 80 years and older had BP under control, as per the guidelines set forth by NHBPEP and JNC 7. These trends were similar for both men (38%) and women (38%) aged 60 years or less.[7] Another study investigated the NHANES data from 2003-2004, to explore inadequate control of HT among adults aged 18 years and older with cardiovascular disease (CVD) co-morbidities such as coronary artery disease (CAD), heart failure (HF), diabetes mellitus (DM), stroke, etc. in the United States (U.S.). The authors reported that 75% of their study population who were hypertensive and taking BP lowering medications; approximately 30-50% of those individuals did not have their BP under control, i.e., SBP and DBP less than 140 and 90 mmHg respectively. Moreover, isolated systolic HT was the most prevalent uncontrolled type of HT among individuals with a mean systolic BP of 20 mmHg higher than normal.[8]

Systolic HT prevalence rates increase with age and, SBP level is the main risk factor for cardiovascular diseases after 50 years of age.[9] The JNC 7 report suggests that there is a greater need to focus on isolated SBP as a major risk factor for CVDs and strokes. Studies have shown that SBP levels continue to rise throughout life, whereas DBP levels start to taper off after 50 years of age.[10, 11] Franklin et al., explored the hemodynamic patterns of age-related changes in BP and found that age-related changes leading to increasing SBP levels and decreasing DBP levels after 50 years of age are

mainly attributed to large artery stiffness. They also suggest that the dominant hemodynamic factor in normotensive and hypertensive individuals is large artery stiffness compared to vascular resistance. If HT is left untreated or uncontrolled, large artery stiffness would worsen, thereby perpetuating a vicious cycle of elevated BP levels and arterial stiffness.[11] Furthermore, guidelines to maintain SBP levels below 140 mmHg among older individuals continue to remain controversial.[9, 12]

Non-adherence to BP lowering medications and recommendations serve as another contributing factor to uncontrolled HT, especially among minority populations. According to The Cohort Study of Medication Adherence in Older Adults (CoSMO), a prospective study among older adults with essential hypertension, the authors found that black participants not only had a significantly higher prevalence of uncontrolled hypertension, but also had a lower level of adherence to BP lowering medications compared to whites. This study reported a strong association between self-reported non-adherence and uncontrolled BP levels determined by clinical readings.[13] Vawter et al. conducted a study to assess barriers to antihypertensive medication adherence among adults in the U.S. The authors found that almost one third of the participants reported several barriers to antihypertensive therapy. "Not remembering" was the most common reason reported (32.4%), followed by high cost (22.6%), having no insurance (22.4%), side effects (12.5%) and other reasons.[14]

Although there have been studies that have investigated adherence issues of antihypertensive therapy, very little is known about the relationship between demographics and adherence issues particularly among older populations.[13, 15] In order to

better develop and implement interventions that are population-specific, culturally competent, and community-based, it is important to understand and assess factors associated with uncontrolled HT. This study aims to assess demographic, self-reported and clinical predictors of uncontrolled HT among individuals taking BP-lowering medications.

Methods

CITIES Project

The CITIES project of North Carolina (NC) was supported for three years by the U.S. DHHS, Office of Minority Health (OMH), and awarded to the Forsyth Medical Center (FMC) Foundation in formal partnership with the Moses Cone Health System (MCHS), the University of North Carolina at Greensboro (UNCG) and the North Carolina Agriculture & Technical State University (NC A&T). This initiative was implemented in two North Carolina counties, Guilford and Forsyth, and targeted minority populations, low-income individuals, those who spoke English as a second language and persons who lived in rural areas. The main components of the CITIES project were to: (a) screen individuals for stroke risk factors; (b) make recommendations and referrals as appropriate for identified risk factors; and (c) provide health education and health promotion activities for stroke risk factors.[16]

Settings and Procedures

Each medical center used a mobile unit and registered nurses (RN) to screen individuals with preset appointments at designated sites in both counties, such as churches, factories, health fairs, etc. and at sites with unscheduled appointments within

the two respective counties. Participation was voluntary and each participant was included if they were 18 years or older and signed the consent form. The RNs used a standard questionnaire that gathered data on self-reported questions, stroke risk profile, and clinical and biomedical measurements. A total of 19,621 individuals were screened for stroke risk factors in the CITIES project. A convenience sub-sample of 2,663 individuals who were taking BP-lowering medications was chosen for this study. The participants were asked to self-report their HT medication status by answering the following question: "Do/Did you take any medications to control your blood pressure?" Inclusion in the sample was based on a 'yes' response to the question about BP-lowering medications.

The RNs measured the blood pressure of each participant using an electronic machine – DYNAMAP, which was wet-tested and calibrated every week. A minimum of two measurements were taken in the seated position with one of the arms outstretched and the lowest BP reading was recorded. If the first reading was high, i.e., high systolic and/or diastolic BP, then BP was measured again after two minutes in the same arm. If the readings on the machine were found to be high on both occasions, then the registered nurses would manually measure the blood pressure twice in the other arm, using a calibrated sphygmomanometer, and then record the lowest readings. All participants who had a BP measurement of 160 mmHg for systolic and/or 100 mmHg for diastolic or higher were referred to an E.R. promptly to get their BP checked again. The RNs also collected demographic information from all participants.

Other self-reported information included overweight status, smoking, exercise status, presence or absence of diabetes mellitus, non-adherence with BP lowering medications and use of lipid-lowering medications.[16] All self-reported information was collected prior to collection of blood samples and recording of clinical and biomedical measurements. Clinical and biomedical measurements included blood LDL, HDL, total cholesterol, triglycerides and glucose levels. BMI was calculated based on self-reported height and measured weight. The project was approved by the respective Institutional Review Boards for each institution.

Statistical Analyses

All cut-points for uncontrolled HT, SBP and DBP levels were based on the JNC 7 definition and classification of HT.[5] MS Access© was used to input data, which was analyzed using PASW statistics software, version 18.[17, 18] The final sample excluded individuals who were not taking BP lowering medications in order to avoid confounding results. The participants' demographic characteristics, self-reported information and clinical measurements were described using frequencies and percentages. Age was dichotomized to test the associations between uncontrolled levels of BP and individuals older than 55 years. Most studies have cited ages 50 to 65 years of age as a cut-off to discern age-related differences in control of HT. Furthermore, 55 years of age was used as a cut-off in our analysis to achieve proportionate sizes in each age category. Bivariate associations were calculated using cross-tabulations to compare self-reported information (yes and no) from the questionnaire with uncontrolled levels of SBP and DBP (yes and no) based on clinical measurements.

Odds ratios and confidence intervals (CI) at 95% were calculated using standard procedures to assess determinants of uncontrolled SBP and DBP. Uncontrolled SBP and DBP, the outcome variables were modeled as a function of independent variables including, demographic characteristics, self-reported information and clinical measurements reported. Binary logistic regression and forward likelihood ratio method were used to evaluate statistically significant predictors of BP control. Separate regression analyses were conducted on a sub-sample of individuals who self-reported to be compliant with BP lowering medications. The Hosmer and Lemeshow Goodness-of-Fit test was conducted to assess the fit of the final model and its estimates. The statistical significance for all analyses was based on the conventional alpha level of significance of 0.05.

Results

A total of 2,663 participants who reported that they did or were taking BP-lowering medications were included in the final analysis. A description of demographic characteristics is provided in Table 1. Almost two-thirds of the participants were females. A majority of the participants were African Americans (52.2%) and 42% were whites. Almost 50% of the participants had a high school level education or less. About one third of the participants had LDL and HDL levels in the high risk categories (see Table 2). Approximately 40% of the participants had moderate to high total blood cholesterol and triglyceride levels. Less than 10% of the sample size had blood glucose levels higher than 150 mg/dl (normal non-fasting levels). Two thirds of the participants were either overweight or obese based on their BMI levels. The mean SBP and DBP levels were

138.39 mmHg (SD = 19.58) and 81.67 mmHg (SD = 10.65) respectively. The prevalence of uncontrolled systolic HT and diastolic HT in our population sample was 43.5 and 22.8 respectively.

A description of self-reported information is presented in Table 3. Less than 15% of the participants reported a personal history and one third reported a family history of CVD. Slightly over half (52.6%) of the participants reported a lack of exercise in their daily lives, while more than half of the participants reported that they were overweight. Approximately one fifth of the participants reported having diabetes. Less than 10% of the population sample reported non-adherence with their BP-lowering medications, citing forgetfulness, side-effects and high cost as potential reasons for non-adherence.

Bivariate analyses using unadjusted odds ratios were explored to assess differences and associations of respondent characteristics with uncontrolled HT (see Table 4). African Americans were more likely to have uncontrolled isolated SBP and DBP compared to whites. Participants who were older than 55 years of age were about 1.5 times as likely to have uncontrolled SBP levels compared to individuals 55 years of age and younger. Participants with less than high school education were more likely to have uncontrolled SBP than those who had a high school level education or more. Participants with no personal history of atrial fibrillation or CVD were more likely to have uncontrolled DBP compared to those who had a history of either of those conditions. Smokers were almost twice as likely to have uncontrolled DBP compared to non-smokers.

Non-adherence with BP-lowering medication recommendations were positively associated with uncontrolled levels of BP. Participants who report non-adherence were more than twice as likely to have uncontrolled isolated SBP and DBP compared to compliant participants. Individuals who were in the obese category based on BMI levels were 1.4 times as likely to have uncontrolled DBP levels compared to normal weight individuals. Similarly, participants with moderate to high risk for increased blood glucose levels were also 1.4 times as likely to have uncontrolled SBP levels as compared to those individuals with normal blood glucose levels.

A multivariate logistic regression using a stepwise forward likelihood ratio indicated that, non-adherence to BP-lowering medications (OR = 2.450, $p = 0.00$), age (OR = 1.666, $p = 0.00$), race (OR = 1.558, $p = 0.00$), blood triglyceride levels (OR = 1.490, $p = 0.00$), and, blood glucose levels (OR = 2.107, $p = 0.01$), and were significant predictors of uncontrolled SBP levels ($\chi^2 = 6.735$, $p = 0.03$, Cox & Snell's $R^2 = 0.04$) (see Table 5). African Americans, individuals older than 55 years of age, self-reported to be non-adherent with BP-lowering medications, with high risk levels of blood glucose and a moderate risk for blood triglyceride levels were more likely to have uncontrolled SBP levels compared to the reference groups. These results were similar to the bivariate analysis discussed above. The Hosmer and Lemeshow Goodness-of-Fit test for the final model was non-significant ($\chi^2 = 9.919$, $p = 0.19$) indicating that the logistic model and its estimates are a good fit. Cross-tabulations were conducted to further explore level of BP control between select groups of individuals that were found to be significant predictors. Approximately 60% of the participants that were African Americans aged 18-55 years

old were controlling their SBP levels below the recommended level of 140 mmHg (n = 717). A multivariate logistic regression using a stepwise forward likelihood ratio also indicated that, age (OR = 0.461, $p = 0.00$), race (OR = 2.173, $p = 0.00$), gender (OR = 1.953, $p = 0.00$), non-adherence with BP-lowering medications (OR = 2.342, $p = 0.00$), personal history of atrial fibrillation (OR = 0.477, $p = 0.03$) and, smoking (OR = 1.376, $p = 0.03$), and were significant predictors of uncontrolled DBP levels ($\chi^2 = 4.528$, $p = 0.03$, Cox & Snell's $R^2 = 0.09$). Males, African Americans, individuals 55 years old or younger, smokers, with no personal history of atrial fibrillation were more likely to have uncontrolled DBP levels compared to their respective reference groups. These results were also similar to the bivariate analysis discussed above. The Hosmer and Lemeshow Goodness-of-Fit test for the final model was non-significant ($\chi = 4.261$, $p = 0.74$) indicating that the logistic model and its estimates are a good fit. Almost two thirds (66.4%) of younger African American females were controlling their diastolic blood pressure levels below the recommended level of 90 mmHg. (n = 521).

In order to evaluate predictors of uncontrolled SBP and DBP among individuals who were taking BP-lowering medications and self-reported to be compliant with the medication recommendations, multivariate logistic regression using a stepwise forward likelihood ratio using this sub-sample ($\chi^2 = 6.244$, $p = 0.04$, Cox & Snell's $R^2 = 0.03$). Age (OR = 1.682, $p = 0.00$), race (OR = 1.561, $p = 0.00$), and blood triglyceride levels (OR = 1.519, $p = 0.00$) were significant predictors of uncontrolled SBP levels (see Table 6). African Americans, individuals older than 55 years of age and those with high risk levels of blood triglycerides were more likely to have uncontrolled SBP levels compared

to the reference groups. The Hosmer and Lemeshow Goodness-of-Fit test for the final model was non-significant ($\chi = 6.055$, $p = 0.41$) indicating that the logistic model and its estimates are a good fit. Age (OR = 0.508, $p = 0.00$), race (OR = 2.172, $p = 0.00$), gender (OR = 1.864, $p = 0.00$), and personal history of atrial fibrillation (OR = 0.374, $p = 0.01$) were significant predictors of uncontrolled DBP levels ($\chi^2 = 7.237$, $p = 0.00$, Cox & Snell's $R^2 = 0.06$). Males, African Americans, individuals younger than 55 years of age, with no personal history of atrial fibrillation were more likely to have uncontrolled DBP levels compared to the reference groups. The Hosmer and Lemeshow Goodness-of-Fit test for the final model was non-significant ($\chi = 1.096$, $p = 0.99$) indicating that the logistic model and its estimates are a good fit. While the pseudo-R^2 in all our models were low, the Hosmer and Lemeshow tests were non-significant indicative of an adequate fit of all the final models with the available data.

Discussion

The mean SBP and DBP levels of our sample fell in the classification for prehypertension for high blood pressure (JNC7). The control rates for HT in our cross-sectional population were slightly higher than the national rates and for those reported in other studies.[6, 19, 20, 21] Among those who had comorbidities associated with HT, approximately 25% of the population sample self-reported as having diabetes mellitus. In addition, two thirds of our population was either overweight or obese based on their BMI levels. Approximately 40% of the participants also had high blood cholesterol and triglyceride levels. The presence of comorbidities such as diabetes mellitus and high risk BMI levels further compounds achievement of BP control.[20]

Despite continued efforts to reduce disparities in management and control of HT, our results indicate that African Americans are at a greater risk for both uncontrolled systolic and diastolic HT. Fongwa et al conducted a qualitative study to evaluate and assess barriers to and facilitators of medication adherence among hypertensive African American women aged 35 years and older.[22] They conducted five focus groups and found that barriers to effective control of HBP were mainly associated with side effects, cost of medications, personal stress, stress from the social system, SES and lack of physical activity among other barriers. The authors also found that facilitators to effective control included, but were not limited to, positive and proactive behavioral and lifestyle changes.

A similar study conducted by Ogedegbe et al found that among hypertensive African American patients in two primary care centers, patient-specific barriers were most commonly reported.[23] These barriers included forgetfulness, beliefs that medications are undesirable and cause impotency, and attitudes such as not taking responsibility for one's health. Other barriers included medication-specific issues, such as side-effects and cost, disease specific issues, such as absence of symptoms versus having symptoms, and logistic-specific issues, such as access to health care and medications. The findings of these studies are consistent with the results of our analyses and other studies conducted among African American populations.[24, 25, 26, 27]

Hyman et al., found that individuals who were at least 65 years old were associated with the highest relative risk and attributable risk of uncontrolled HT.[9] Our findings suggest that individuals who are older than 55-years-of-age were at the greatest risk for failure to control their SBP levels whereas younger individuals were more likely

to suffer from uncontrolled DBP levels. Similar findings have been reported in other studies that investigated the role of SBP and DBP levels in coronary heart disease risk change with aging.[28, 29] Other studies have also shown that lack of control of SBP as a result of inadequate management are largely responsible for poor overall control of HBP levels in the U.S. population.[9, 30, 31, 32] Growing evidence supports the notion that physicians should focus on controlling elevated SBP particularly in older individuals.[33, 34] Studies that have surveyed physicians have shown that three fourths of them did not initiate appropriate treatment in older individuals with SBP of 140 mmHg or more. Moreover most providers did not pursue NHBPEP stipulated goals of controlling SBP to levels less than 140 mmHg.[35, 36] JNC 7 reports that most physicians are trained to focus on DBP levels and treat it accordingly, as opposed to SBP levels, which have a more dire effect on individuals affected by hypertension after the age of 50 years.

Based on our findings, we support the recommendation purported by NHBPEP to focus on controlling SBP as a means to effectively manage HT particularly in older adults. It is also recommended for practitioners to design interventions to better manage HT-associated risk factors such as high cholesterol, high BMI and diabetes, and target males, African-Americans and younger individuals to adequately control their DBP levels.

Conclusion

In conclusion, few studies have comprehensively evaluated the information regarding predictors of uncontrolled BP levels, such as demographic characteristics, self-reported co-morbidities and clinical correlates of hypertension. Age, race and medication

non-adherence were significant predictors of both isolated uncontrolled SBP and DBP levels. Similar results were found for individuals who were adherent with BP-lowering medications. Although the efforts of NHBPEP have shown improvements in awareness, treatment and control of HBP, one third of the U.S. population still suffers from uncontrolled hypertension. African Americans are more prone to suffer from uncontrolled hypertension as compared to other racial/ethnic groups.

The goal of Healthy People 2010 was to decrease the prevalence of hypertension among African American from 40% to 16%. Several studies have shown that uncontrolled BP levels are mainly attributable to systolic pressure. JNC 7 has emphasized the need for practitioners and public health professionals to focus on controlling SBP levels among hypertensive populations. Further research and clinical trials may be warranted to support this plan of action. Forty three percent of our sample had uncontrolled systolic HT. Future drug trials could elucidate the differential effects of BP-lowering medications on controlling isolated SBP or DBP levels. There is also a growing need for healthcare providers to better manage and target systolic HT to achieve better overall control of HT particularly in the older populations. Finally, public health research and interventions for HT and other correlated CVD risk factors should be designed to reduce gender and racial disparities.

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Tables

Table 1: Demographic Characteristics of Respondents* in CITIES Project, NC 2004-2007		
Personal Characteristics	Total	
	N (2,663)	%
Gender		
Female	1,840	69.3
Male	816	30.7
Race		
Caucasian	1,118	42.0
African American	1,391	52.2
Hispanic	14	0.5
Asian/Pacific Islander	44	1.7
Other	52	2.0
Age		
18 to 55 years old	1,238	46.7
< 55 years old	1,412	53.3
Income		
< $35,000	1,782	70.7
≥ $35,000	738	29.3
Education		
Less than High School	193	7.4
High School or GED	1,008	38.8
More than High School	1,396	53.8
Ethnicity		
Hispanic/Latino	44	1.7
Non-Hispanic/Latino	2575	98.3

* Totals do not sum to the sample size due to missing data.

Table 2: Clinical Characteristics of Respondents* in CITIES Project, NC 2004-2007		
Clinical Characteristics	Total	
	N (2,663)	%
LDL		
Optimum (≤ 99 mg/dl)	641	30.9
Near Optimum/Above Optimum (100-129 mg/dl)	833	40.1
Borderline High Risk (130-159 mg/dl)	434	20.9
High Risk (160-189 mg/dl)	129	6.3
Very High Risk (≥ 190 mg/dl)	38	1.8
HDL		
Preventive (≥ 60 mg/dl)	602	23.0
Normal (40-59 mg/dl)	1,244	47.6
High Risk (< 40 mg/dl)	770	29.4
Total Cholesterol		
Normal (≤ 199 mg/dl)	1,649	62.7
Moderate Risk (200-239 mg/dl)	741	28.2
High Risk (≥ 240 mg/dl)	240	9.1
Triglyceride		
Optimum (≤ 149 mg/dl)	1,385	52.7
Borderline High Risk (150-199 mg/dl)	479	18.2
High Risk (≥ 200 mg/dl)	762	29.0
Blood Glucose		
Normal (50-149)	2,359	89.9
Moderate Risk (150-199 mg/dl)	174	6.6
High Risk (≥ 200 mg/dl)	92	3.5
BMI		
Underweight (≤ 18.5)	24	0.9
Normal (18.5-24.9999)	436	16.5
Overweight (25-29.9999)	885	33.5
Obese (≥30)	1,295	49.1
Systolic BP		
Controlled (normal) (≤ 119 mmHg)	1,485	56.5
Uncontrolled (> 119 mmHg)	1,141	43.5
Diastolic BP		
Controlled (normal) (≤ 79 mmHg)	2,022	77.2
Uncontrolled (> 79 mmHg)	598	22.8
Combined Systolic and Diastolic BP		
Controlled (normal)	2,121	81.5
Uncontrolled	480	18.5

*Totals do not sum to the sample size due to missing data.

Table 3: Self-Reported Characteristics of Respondents* in CITIES Project, NC 2004-2007		
Self-Reported Characteristics	Total	
	N (2,663)	%
Personal History of CVD		
No	2,281	85.7
Yes	382	14.3
History of Atrial Fibrillation		
No	2,548	95.7
Yes	115	4.3
Family History of CVD		
No	1,774	66.6
Yes	889	33.4
Smoking		
No	2,256	84.7
Yes	407	15.3
Overweight Status		
No	941	35.3
Yes	1,722	64.7
Lack of Exercise Status		
No	1,263	47.4
Yes	1,400	52.6
High Blood Cholesterol Status		
No	1,497	56.2
Yes	1,166	43.8
Diabetes Status		
No	2,102	78.9
Yes	561	21.1
Stress Status		
No	2,044	76.8
Yes	619	23.2
Non-compliance with BP-Lowering Medications		
No	2,453	92.1
Yes	210	7.9
Due to High Costs	29	14.4
Due to Side-effects	45	22.4
Due to Forgetfulness	56	27.9
Due to Other Reasons	71	35.3

*Totals do not sum to sample size due to missing data

Table 4: Bivariate Analysis – Determinants of Uncontrolled SBP and DBP by Demographic, Self-Reported and Clinical Characteristics in CITIES Project, NC 2004-2007

Participant Characteristics	SBP Odds Ratio (95% CI)	DBP Odds Ratio (95% CI)
Gender		
Female (reference)	--	--
Male	0.975 (0.825, 1.153)	1.554* (1.283, 1.882)
Race		
Caucasian (reference)	--	--
African Americans	1.414* (1.204, 1.661)	2.350* (1.917, 2.881)
Age		
18-55-years-old (reference)	--	--
Older than 55-years-old	1.522* (1.302, 1.779)	0.428* (0.355, 0.517)
Income		
> $35,000 (reference)	--	--
≤ $35,000	1.468* (1.229, 1.753)	1.039 (0.846, 1.277)
Education		
Less than High School (reference)	--	--
High School or More	0.819* (0.701, 0.958)	1.093 (0.908, 1.316)
Personal History of CVD		
No (reference)	--	--
Yes	1.057 (0.848, 1.318)	0.598* (0.445, 0.802)
History of Atrial Fibrillation		
No (reference)	--	--
Yes	1.118 (0.768, 1.627)	0.505* (0.291, 0.877)
Family History of CVD		
No (reference)	--	--
Yes	0.998 (0.847, 1.175)	0.895 (0.736, 1.088)
Smoking Status		
No (reference)	--	--
Yes	1.186 (0.958, 1.467)	1.735* (1.373, 2.192)
Overweight Status		
No (reference)	--	--
Yes	1.039 (0.884, 1.221)	1.168 (0.962, 1.417)
Lack of Exercise Status		
No (reference)	--	--
Yes	1.044 (0.895, 1.219)	1.191 (0.991, 1.431)
Non-adherence with BP-Lowering Medications		
No (reference)	--	--
Yes	2.431* (1.806, 3.271)	2.398* (1.783, 3.226)
High Blood Cholesterol Status		
No (reference)	--	--
Yes	0.905 (0.775, 1.058)	0.592* (0.489, 0.716)

Diabetes Status		
No (reference)	--	--
Yes	1.268* (1.050, 1.531)	0.649* (0.509, 0.827)
Stress Status		
No (reference)	--	--
Yes	0.930 (0.774, 1.117)	1.094 (0.884, 1.354)
Total Blood Cholesterol		
Normal (reference)		
Moderate to High Risk	1.066 (0.908, 1.251)	1.177 (0.976, 1.419)
LDL		
Normal (reference)	--	--
High Risk	1.007 (0.827, 1.225)	1.240 (0.992, 1.550)
HDL		
Normal (reference)	--	--
High Risk	0.886 (0.747, 1.052)	0.933 (0.761, 1.143)
Triglycerides		
Normal (reference)	--	--
Moderate Risk	1.266 (1.027, 1.561)*	1.111 (0.871, 1.417)
High Risk	1.071 (0.895, 1.281)	0.904 (0.729, 1.122)
BMI		
Normal (reference)	--	--
Underweight	1.186 (0.521, 2.698)	1.726 (0.693, 4.298)
Overweight	0.769* (0.610, 0.970)	1.130 (0.847, 1.509)
Obese	0.992 (0.798, 1.234)	1.402* (1.069, 1.838)
Blood Glucose		
Normal (reference)	--	--
Moderate to High Risk	1.412 * (1.093, 1.823)	0.975 (0.718, 1.323)

* Significant at $p < 0.05$

Table 5: Logistic Regression – Predictors of Uncontrolled SBP and DBP by Demographic, Self-Reported and Clinical Characteristics in CITIES Project, NC 2004-2007			
Participant Characteristics	β	SBP Odds Ratio (95% CI)	*p*
Adherence to BP Medications			
Yes (Reference)	--	--	--
No	0.896	2.450 (1.738, 3454)*	0.00
Age			
18-55-years-old (reference)	--	--	--
Older than 55-years-old	0.510	1.666 (1.376, 2.017)*	0.00
Race			
Caucasian (reference)	--	--	--
African Americans	0.443	1.558 (1.272, 1.908)*	0.00
Hispanics/Latinos	0.671	1.957 (0.508, 7.541)	0.32
Asians/Pacific Islander	0.487	1.627 (0.779, 3.396)	0.19
Others	0.452	1.572 (0.796, 3.105)	0.19
Triglycerides			
Normal (reference)	--	--	--
Moderate Risk	0.399	1.490 (1.164, 1.907)*	0.00
High Risk	0.217	1.242 (0.982, 1.571)	0.07
Blood Glucose			
Normal (reference)	--	--	--
Moderate Risk	-0.069	0.933 (0.610, 1.427)	0.74
High Risk	0.745	2.107 (1.171, 3.791)*	0.01
Participant Characteristics	β	DBP Odds Ratio (95% CI)	*p*
Age			
18-55-years-old (reference)	--	--	--
Older than 55-years-old	-0.775	0.461 (0.367, 0.579)*	0.00
Race			
Caucasian (reference)	--	--	--
African Americans	0.776	2.173 (1.708, 2.765)*	0.00
Hispanics/Latinos	0.919	2.507 (0.588, 10.682)	0.21
Asians/Pacific Islander	1.050	2.857 (1.309, 6.233)*	0.00
Others	0.290	1.337 (0.580, 3.082)	0.49
Gender			
Female (reference)	--		--
Male	0.669	1.953 (1.543, 2.472)*	0.00
Adherence to BP Medications			
Yes (Reference)	--		--
No	0.808	2.242 (1.580, 3.183)*	0.00
H/O[a] Atrial Fibrillation			
No (Reference)	--		
Yes	-0.741	0.477 (0.242, 0.938)*	0.03

Smoking Status			
Non-Smoker (Reference)	--		
Smoker	0.320	1.376 (1.029, 1.842)*	0.03

* Significant at $p < 0.05$

[a] H/O – History Of

Table 6: Logistic Regression – Predictors of Uncontrolled SBP and DBP by Demographic, Self-Reported and Clinical Characteristics Among Compliant Participants in CITIES Project, NC 2004-2007

Participant Characteristics	β	SBP Odds Ratio (95% CI)	*p*
Age			
18-55-years-old (reference)	--	--	--
Older than 55-years-old	0.520	1.682 (1.380, 2.050)*	0.00
Race			
Caucasian (reference)	--	--	--
African Americans	0.446	1.561 (1.267, 1.924)*	0.00
Hispanics/Latinos	1.020	2.773 (0.643, 11.968)	0.17
Asians/Pacific Islander	0.534	1.706 (0.822, 3.542)	0.15
Others	0.270	1.309 (0.636, 2.697)	0.46
Blood Triglyceride Levels			
Normal (reference)	--	--	--
Moderate Risk	0.418	1.519 (1.179, 1.958)*	0.00
High Risk	0.186	1.205 (0.943, 1.539)	0.13
Participant Characteristics	β	DBP Odds Ratio (95% CI)	*p*
Age			
18-55-years-old (reference)	--	--	--
Older than 55-years-old	-0.677	0.508 (0.401, 0.644)*	0.00
Race			
Caucasian (reference)	--	--	--
African Americans	0.775	2.172 (1.686, 2.797)*	0.00
Hispanics/Latinos	1.172	3.228 (0.735, 14.165)	0.12
Asians/Pacific Islander	1.056	2.876 (1.327, 6.231)*	0.00
Others	-0.063	0.939 (0.350, 2.516)	0.90
Gender			
Female (reference)	--	--	--
Male	0.623	1.864 (1.456, 2.385)*	0.00
H/O[a] Atrial Fibrillation			
No (Reference)	--	--	--
Yes	-0.983	0.374 (0.168, 0.835)*	0.01

* Significant at $p < 0.05$

[a] H/O – History Of

CHAPTER V

EPILOGUE

Findings from study 1 suggest that individuals who had a possible diagnosis of hypertension based on their clinical measures were likely to report as not having hypertension. The sensitivity of self-reported information about one's hypertension status was low. The overall agreement between one's self-reported information and actual clinical measures, based on kappa scores were only fair. Therefore, self-reported information for hypertension should be used only with great care as a screening tool in large, population-based studies. Almost 25% of the participants in our sample had high blood pressure based on their clinical measures. Several national studies have reported similar findings.

Despite continued efforts to raise awareness and educate the general population about hypertension; approximately one third of the U.S. population is unaware of their hypertension status. Therefore it is imperative to plan population-based interventions that target individuals most in need. This study identified several participant characteristics that were significantly associated with negative congruency i.e. decreased awareness of one's hypertension status. These characteristics included gender (males), race (African-Americans), age (those aged 55 years and older), and those who were in a high risk category for several hypertension and CVD-related correlates (HDL, triglycerides etc.).

Hence future interventions should employ strategies that increase availability and encourage participation of individuals in preventative care services, including getting an annual physical. The authors of this study collected information on possible diagnosis of hypertension; thus future research could also focus on evaluating the accuracy of screening data as an indicator of actual diagnosis of hypertension.

Based on the findings of study 2, almost half of the participants who were taking blood pressure lowering medications had uncontrolled systolic hypertension. Almost 25% of the participants were not controlling their diastolic blood pressure levels below the recommended JNC 7 levels. The mean systolic and diastolic blood pressure fell in the JNC 7 classification for prehypertension. The findings of this study suggest that racial disparities continue to persist when it comes to controlling blood pressure levels. African Americans were at the greatest risk to suffer from uncontrolled systolic and diastolic hypertension compared to whites.

This study also found that participants older than 55 years of age were more likely to have isolated uncontrolled systolic hypertension compared to younger participants. The National High Blood Pressure Education Program has recommended that physicians focus on better management of systolic blood pressure as a means to achieve optimum control of overall hypertension rates in the population. Several studies have shown that physicians do not adequately address management of systolic blood pressure particularly in older adults. Our results support NHBPEP's call to enhance management of systolic blood pressure in older adults. Furthermore, future interventions could also target African

Americans males that are younger than 55 years of age to raise awareness, and control diastolic blood pressure levels.

Strengths and Limitations

Strengths:

1. The strengths of this study include a large cross-sectional sample size and the availability of clinical measurements of BP and other associated correlates.
2. Both studies were conducted in one of the stroke belt states, NC, which has higher stroke mortality rates when compared to the national average. To our knowledge, only a few studies have attempted to comprehensively evaluate the validity of self-reported information and assess independent correlates of congruency of HT status in the stroke belt.
3. These studies also used current definitions of HT as proposed by JNC 7 that served as 'gold standards' to investigate the validity and predictors of positive congruency of HT status.
4. For study 1, we excluded individuals who were taking BP-lowering medications in order to avoid confounding of results. All individuals who self-reported as taking BP-lowering medications were automatically considered as self-reported hypertensive. It is important to note that, if these individuals were included in our final analysis, it would have led to an over-estimation of sensitivity of the screening test.

Limitations:

1. One limitation of both studies was that, participation in this study was voluntary as opposed to recruitment of a more generally representative segment of the population.

As a result, authors may have missed out on capturing information from non-participants with a different set of knowledge about HT and its correlates.

2. Another limitation of the studies was the use of only two readings of clinical BP in order to determine possible diagnosis of HT. The clinical measures of BP varies during the day and from day-to-day, therefore more stringent criteria have been suggested to diagnose HT in order to avoid over-estimation of clinical HT.
3. Another possible limitation is 'white-coat HT', which reflects the stressful influence of nurses and the presence of clinical staff on one's BP.
4. Another limitation of study 2 was that the researchers did not collect information on the type of BP-lowering medications taken by the population sample. This would have allowed the authors to assess the effects of medications in controlling SBP and/or DBP levels and provide pharmacological linkage to management of HT.
5. Less than 10% (n = 210) of participants indicated non-adherence to BP-lowering medications. Non-adherence to medications can be defined as not following clinically prescribed recommendations of regularly taking BP-lowering medications. We did not collect information if the participants were taking pills on alternate days or taking half the recommended dosage or were taking medications when he/she perceived symptoms related to high BP. It is quite possible that the number in our sample could have been higher if more accurate information was gathered concerning non-adherence.

Future Work

The results from these studies should be expanded to develop more culturally-competent and comprehensive population-based interventions that increase the availability and encourage individuals to access preventive healthcare services including getting an annual physical. It is hypothesized that individuals who have regular access to healthcare services and get an annual physical will be more aware of their health status including risk factors associated with hypertension, CVD and stroke. Very few studies have assessed the associations between healthcare access and awareness of basic health information. Future research could be designed to focus on evaluating this association to better predict health outcomes for the populations. Several groups of individuals were either more likely to be unaware of their hypertension status or were less likely to control their blood pressure levels below the recommended JNC 7 levels. More research is needed to better explore compliance rates among African Americans and understand the differential effects of blood pressure lowering drugs. Healthcare professionals are encouraged to design intervention plans that include behavioral modifications and healthy lifestyle choices as a compliment to pharmaceutical management of high blood pressure. The findings of these studies could be used to develop targeted educational messages that focus on reducing racial and gender disparities and betterment of awareness, treatment and control of hypertension. I have been a part of this research project and team since 2004. This research project and the mentorship provided by the CITIES staff has allowed me to gain more knowledge and a better understanding of population dynamics related to

hypertension and CVD. I have thoroughly enjoyed working on these two studies and look forward to enhancing my skills in this area at both personal and professional levels.

APPENDIX A.

DATA INSTRUMENT

CITIES Cardiovascular Risk Factor Assessment and Recommendations

Screening Date:	Screening Location:	MIG ☐

Participant to complete all requested information in the shaded area below

Last Name	First Name	MI
Street Address:		
City	State / Zip Code	Within City Limits: ☐ Yes ☐ No
Daytime Phone Number	Evening Phone Number	Age
Birth Date	Sex: ☐ M ☐ F	Income: ☐ $35,000/yr or less ☐ More than $35,000/yr

Race:	Ethnicity:	Language:
☐ Black/African American ☐ Asian ☐ Native Hawaiian/Other Pacific Islander ☐ American Indian/Alaska Native ☐ White/Caucasian ☐ Other _____	☐ Hispanic/Latino ☐ Non-Hispanic/Latino	Do you speak English? ☐ Yes ☐ No Other Language _____

Education: ☐ Less than High School ☐ High School/GED ☐ More than High School

Best Time for Follow-Up Call: Day _____ Time _____

Cardiovascular (CV) Risk Factors (Self-reported)	
☐ Personal history of CV disease*	☐ High Blood Cholesterol* On meds ☐
☐ History of Atrial Fibrillation	☐ Non-Compliant w/meds? Why? ☐ Cost
☐ Family history of premature CV disease*	☐ Side effects ☐ Forget ☐ Other _____
☐ Smoking*	☐ Diabetes*
☐ Overweight	Last time ate or drank? _____
☐ Lack of exercise	☐ Stress
☐ High Blood Pressure* On meds ☐	☐ Age: Male > 45 Female > 55*

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CITIES Cardiovascular Risk Factor Assessment and Recommendations

Name:	Date:	Location:

Data	Normal Values
Height: _____feet _____ inches	
Weight: _____ lbs	
BMI: _____	19-24
Waist Circumference _____ in	
*BP: _____/_____ mm Hg	<120/80 mm Hg
Pulse: _____ beats/min	60-100 beats/min
Total Cholesterol: _____ mg/dL	<200 mg/dL
*HDL: _____ mg/dL	>40 mg/dL
LDL: _____ mg/dL	<100/<130 mg/dL
Triglycerides: _____ mg/dL	<150 mg/dL
Blood Glucose: _____ mg/dL	≤100 mg/dL fasting
Fasting: ☐ Yes ☐ No	<140 mg/dL non-fasting

Results: Your current risk for heart disease or stroke is: ☐ Low Risk ☐ Moderate Risk ☐ High Risk
However, if you have 3 or more risk factors(*), your risk for heart disease or stroke later in life will increase. Take steps now to lower your risk.

Recommendations: Based on your results, we recommend you:

- ☐ Quit Smoking
- ☐ Lose weight
- ☐ Increase exercise
- ☐ Lower your Blood Pressure
- ☐ Check BP 2 more times. If > 140/90 all 3 times, call your doctor for an appointment.
- ☐ Lower your Cholesterol
- ☐ Control your diabetes/Lower your Blood Sugar
- ☐ Manage your stress
- ☐ Notify your physician's office of screening results and continue to follow-up with your doctor.
  - ☐ Recommend fasting lipid panel at next appointment.
  - ☐ Recommend fasting glucose at next appointment.
- ☐ Physician Referral needed

Classes: Please review the handouts provided and attend the following classes:

☐ Smoking Cessation	☐ Blood Pressure Management	☐ Diabetes Management
☐ Nutrition/Weight Management	☐ Cholesterol Management	☐ Stress Management
☐ Exercise	☐ Medication Compliance	

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72589 (Rev. 6/1/2005) Screened by: _____ (initial) Page 2 of 2

APPENDIX B:

IRB EXEMPTION APPROVAL

Title of Project: ***Secondary Analysis and Reporting of the CITIES Hypertension Data***

Principal Investigator: ***Daniel Bibeau*** Department: ***Public Health Education***
***Students are not eligible to be principal investigators**

Have you taken CITI training? X Yes (If Yes, you do not need to attach a copy of your training certificate) ☐ No (If No, then please attach proof of the completion of our accepted human subjects' training)

Campus Address: ***437 HHP Building***

Email: ***dlbibeau@uncg.edu*** Phone: ***334-3240*** Fax:

RANK: X Faculty ☐ Staff ☐ Other (specify):

Source of funding for your study (internal or external): RAMSES Number:

Co-Investigator: ***Mark Schulz and Robert Aronson*** Department: ***Public Health Education***

Have you taken CITI training? X Yes (If Yes, you do not need to attach a copy of your training certificate) ☐ No (If No, then please attach proof of the completion of our accepted human subjects' training)

Campus Address: ***437 HHP Building***

Email: ***mrschulz@uncg.edu, rearonso@uncg.edu*** Phone: ***334-5517, 256-0119*** Fax:

If this project represents student work please provide the student researcher rank:

☐Undergraduate; ☐ Masters; or X Doctoral

Student Researchers name: ***Gaurav Dave***

Have you taken CITI training? ☐ Yes (If Yes, you do not need to attach a copy of your training certificate) X No (If No, then please attach proof of the completion of our accepted human subjects' training)

Email: ***gjdave@uncg.edu*** Phone: ***334-5044*** Fax:

Principal Investigator's Statement of Responsibility
As the principal investigator, my signature testifies that I have read and understood the University Policy and Procedures for the Use of Human Participants in Research. I assure the Committee that all procedures performed under this project will be conducted exactly as outlined in the Proposal Narrative and that any modification to this protocol will be submitted to the Committee in the form of a modification for its approval prior to implementation.
☐ The proposed research does not include any of the items that are listed in Item B of the Exemption Overview

_____ _____
Signature of Principal Investigator Date

_____ _____
Signature of Co-Investigator (if applicable) Date

_____ _____
Signature of Co-Investigator (if applicable) Date

Student Researcher's Statement of Responsibility
As a student researcher, I accept responsibility for ensuring that this project complies with all obligations listed above for the Principal Investigator.

_____ _____
Student Researcher(s) Date

For IRB use only

☐ Exemption Granted ☐ Not Exempt, full protocol necessary

Exempt Under: ☐ b.1 ☐ b.2 ☐ b.3 b.4 ☐ b. 5 ☐

_____ _____
IRB Reviewer Date

IRB Notice

IRB <irbcorre@uncg.edu> Mon, Sep 20, 2010 at 15:31
To: bibeau@uncg.edu
Cc: gjdave@uncg.edu, cifarrio@uncg.edu, irbcorre@uncg.edu

To: Daniel Bibeau
Public Health Education
437G HHP Building

From: UNCG IRB

Date: 9/20/2010

RE: Notice of IRB Exemption
Exemption Category: 4.Existing data, public or deidentified
Study #: 10-0322Study Title: Secondary Analysis and Reporting of the CITIES Hypertension Data

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

The purpose of this project is to analyze the hypertension related data gathered as part of the CITIES stroke risk reduction project for the purpose of professional communication through presentations and publications.

Investigator's Responsibilities

Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented. The IRB will maintain records for this study for three years from the date of the original determination of exempt status.

CC:Gaurav Dave, Ctr Soc, Cmty Hlth Rsch And Eval, Chris Farrior, (ORED), Non-IRB Review Contact, (ORC), Non-IRB Review Contact

APPENDIX C:

ADDITIONAL ANLYSES

1. Predictors of Congruency (Self-Reported versus Clinical Measures)

After controlling for other covariates, a multivariate logistic regression using stepwise likelihood ratio model found that gender ($p = 0.00$), race ($p = 0.00$), age ($p = 0.00$), family history of CVD ($p = 0.00$), self-reported diabetes status ($p = 0.02$), total blood cholesterol ($p = 0.00$), HDL levels ($p = 0.00$), blood triglyceride levels ($p = 0.00$), and BMI ($p = 0.00$) were all statistically significant predictors of congruency. Cross-tabulations and unadjusted odds ratios were conducted to further explore level of congruency between select groups of individuals that were found to be significant predictors. Males were 0.7 times less likely to be congruent with respect to the hypertension status compared to females (see Table 1). African-American females were 0.8 times less likely to be congruent compared to white females. Furthermore, white females who were older than 55 years of age or 41-55 years old were less likely to be aware of their hypertension status compared to white females who were younger (18-40 years old).

Table 1: Bivariate Analysis – Determinants of HT Awareness (Congruence) by Select Demographic Characteristics in CITIES Project, NC 2004-2007

Participant Characteristics	Odds Ratio	95% CI
Gender		
Female (reference)	--	--
Male	0.732*	0.679, 0.789
Race		
White Females (reference)	--	--
African American Females	0.809*	0.733, 0.894
Age (White Females)		
18-40 years old (reference)	--	--
41 to 55 years old	0.395*	0.321, 0.486

> 55 years old	0.229*	0.185, 0.284

* Significant at $p < 0.05$

Approximately $4/5^{th}$ of the participants (88%) that were white females aged 18-40 years old were positively congruent i.e. more aware of their HT status (n = 3768).

2. Predictors of uncontrolled systolic hypertension

After controlling for other covariates, a multivariate logistic regression using a stepwise forward likelihood ratio indicated that, non-adherence to BP-lowering medications (OR = 2.450, $p = 0.00$), age (OR = 1.666, $p = 0.00$), race (OR = 1.558, $p = 0.00$), blood triglyceride levels (OR = 1.490, $p = 0.00$), and, blood glucose levels (OR = 2.107, $p = 0.01$), and were significant predictors of uncontrolled SBP levels ($\chi^2 = 6.735$, $p = 0.03$, Cox & Snell's $R^2 = 0.04$) (see Table 5). African Americans, individuals older than 55 years of age, self-reported to be non-adherent with BP-lowering medications, with high risk levels of blood glucose and a moderate risk for blood triglyceride levels were more likely to have uncontrolled SBP levels compared to the reference groups. Cross-tabulations and unadjusted odds ratios were conducted to further explore level of congruency between select groups of individuals that were found to be significant predictors (see table 2). African Americans were 1.4 times more likely to suffer from uncontrolled systolic hypertension (HT) compared to whites. African American individuals who were older than 55 years of age were 1.5 times more likely to have uncontrolled systolic blood pressure levels compared to younger African Americans.

Table 2: Bivariate Analysis – Determinants of Uncontrolled Systolic Hypertension by Select Demographic Characteristics in CITIES Project, NC 2004-2007		
Participant Characteristics	Odds Ratio	95% CI
Race		
White (reference)	--	--
African American	1.414*	1.204, 1.661
Age (African Americans)		
18-55 years old (reference)	--	--
> 55 years old	1.556*	1.255, 1.929
* Significant at $p < 0.05$		

Approximately 60% of the participants that were African Americans aged 18-55 years old were controlling their systolic blood pressure levels below the recommended level of 140 mmHg. (n = 717).

3. Predictors of uncontrolled diastolic hypertension

After controlling for other covariates, a multivariate logistic regression using a stepwise forward likelihood ratio also indicated that, age (OR = 0.461, $p = 0.00$), race (OR = 2.173, $p = 0.00$), gender (OR = 1.953, $p = 0.00$), non-adherence with BP-lowering medications (OR = 2.342, $p = 0.00$), personal history of atrial fibrillation (OR = 0.477, $p = 0.03$) and, smoking (OR = 1.376, $p = 0.03$), and were significant predictors of uncontrolled DBP levels ($\chi^2 = 4.528$, $p = 0.03$, Cox & Snell's $R^2 = 0.09$). Males, African Americans, individuals 55 years old or younger, smokers, with no personal history of atrial fibrillation were more likely to have uncontrolled DBP levels compared to their respective reference groups. Cross-tabulations and unadjusted odds ratios were conducted to further explore level of congruency between select groups of individuals that were found to be significant predictors (see table 3). African Americans were 2.3 times more likely to suffer from uncontrolled diastolic hypertension compared to whites. African

Americans who were older than 55 years of age were 0.4 times less likely to have uncontrolled diastolic blood pressure compared to younger African Americans. Furthermore, African Americans males who were 55 years of age and younger were 1.5 times more likely to have uncontrolled diastolic blood pressure levels compared to African American females in the same age group.

Table 3: Bivariate Analysis – Determinants of Uncontrolled Diastolic Hypertension by Select Demographic Characteristics in CITIES Project, NC 2004-2007

Participant Characteristics	Odds Ratio	95% CI
Race		
White (reference)	--	--
African American	2.350*	1.917, 2.881
Age (African Americans)		
18-55 years old (reference)	--	--
> 55 years old	0.473*	0.371, 0.603
Gender (African Americans 18-55 years)		
Female (reference)	--	--
Male	1.511*	1.074, 2.126

* Significant at $p < 0.05$

Almost two thirds (66.4%) of younger African American females were controlling their diastolic blood pressure levels below the recommended level of 90 mmHg. (n = 521).

DONE!